Chapter 4

Methodology

4.1 Introduction

This research tests the hypothesis that the adverse selection model of insurance market is consistent with the observed structure of insurance rates. This means if the hypothesis is correct, then the insurance policies issued to observably homogeneous consumers (consumers in the same risk class, e.g. occupation, age, marital status etc) will exhibit increasing unit prices as the amount of coverage purchased rises.

This chapter and the next intends to examine whether or not policy size has a positive effect on the price of insurance after allowing for economics of scale in issuing policies as well as other relevant factors such as the type of policy and the age and marital status of the insured individuals. The annual gross premium (the amount calculated on a yearly basis, actually paid by the purchaser) can be viewed as having two components; net premium, which reflects the actuarially determined cost of providing the policy's benefits, and loading, which reflects the cost of issuing and maintaining the policy plus profit or dividend return and contribution to surplus. A policy's net premium is determined by general mortality experience, allowance for the additional risk derived from adverse selection will be revealed in the loading function. Consumers desiring unusually large amount of coverage, only be sold policies with larger than average loading factors. A consumer's purchase options are determined what he/she is shown by an agent, the hypothesized correlation between policy size and the size of the loading factor is compatible with an increasing unit price of coverage for any individual policy. So even if

the loading factor is constant for each policy, the policy purchased by a group of homogeneous individual may exhibit the hypothesized correlation between the loading factors and the amount of coverage purchased.

The theories testes here assume a perfect competitive market structure. There are, however, questions remained about the plausibility of this market structure. In the first place, the range of policy types and options are so complex that consumers are unlikely to possess the "perfect information" with respect to product characteristics that is necessary for the existence of a competitive market. In other word, the number of available policy is so large that no consumer can be reasonably assume to be fully informed with respect to all possible provisions and options. The analysis, therefore, must consider whether a competitive economic model is relevant to an industry in which consumers opt for "fair odds" in their insurance selection to analyze the presence of quadratic pricing. Even with all the above mentioned complexity and constraints, the hypothesized quadratic pricing still can be observed. This is because when consumers purchased insurance from an agent, he will be choosing from a menu of policies determined by the agent rather than the full universe of policy. Consumers will select, albeit within the limits imposed by their informational constraints, the amount of coverage purchased. People wish to purchase larger coverage can also be expected to do so.

Insurer's price structure will need to cover their costs in order to remain in business. It is assumed that the price structure will include adjustments for the anticipated risks from adverse selection that go along with extraordinarily large purchase of insurance. In other word, while the insurer's size can be expected to affect the absolute level of policy cost, this should not affect any adjustment for anticipated cost due to adverse selection as

policy size rises. This means small and large insurers will bear the effect of adverse selection, thus quadratic pricing strategy applies to both type of insurers.

The signaling models of insurance markets assert that for observably identical individuals, the unit price of insurance will increase with the amount of coverage purchased. Intuitively, if a consumer purchases an excessive amount of coverage relative to his or her stated circumstances, he or she will be able to do so only by paying a greater per unit price for the coverage. The obvious way to test this hypothesis would be examined by the insurance purchased by group of homogeneous individual-purchasers of the same age, sex, income, marital status etc. It could then be determined if, for such a group the marginal cost of insurance is an increasing function of the amount of coverage purchased.

As no data are available on consumer insurance portfolios, the presence of this type of signaling cannot be established. Fortunately, while most consumers purchased portfolio of policy, it may still be possible to confirm the presence of signaling through the examination of individual policy because the fixed cost component of policy premia creates falling average costs of coverage for the consumer. This provides an incentive for consumers to concentrate their insurance purchase by purchasing their desired level of coverage by combining policies that are as large as possible. Assume, for simplicity, that all insurers incur equal fixed cost per policy. Furthermore, it is useless to purchase more than one separate policy covering the same risk type. As either the loss incurred will be equally shared by the insurers, or only one insurer will bear the total loss if the loss incurred falls within the coverage limit. This explains why we use individual policy is sufficient to measure the presence of quadratic pricing.

4.2 Data

The model is estimated using data collected from 600 policies issued in the year 2003 from 3 largest insurance companies in Malaysia. Due to private and confidential policy practiced by the companies, the companies and identity of insureds are not disclosed. Unfortunately much of the data was unsuitable for analysis. The major limitations are with respect to the policy characteristics. In particular, much of the policies do not have common characteristics, which render it incompatible to assess the level of risk, e.g. some of the policies do not have demographic features and class of occupation. This limitation reduced the size of the usable sample by one third. In the resulting sub-sample, observations are also excluded if the insured was not the policy owner (e.g. children policy under adult's name), single parent policies, and if the riders attached to one policy but not a common rider in other policies. The policies ultimately chosen for analysis are those from common type; i.e. the policies are compatible to one another due to common riders and characteristics.

The Health and Surgical Insurance policy used in the analysis belong to non-participating type. It means the premium paid will not be accumulated to form any cash value. In particular the policy purchased has to be renewed every year, and any non-payment will result in policy termination.

4.3 Assessing The Non-linearity In Prices

We directly test the non-linearity in prices using the price schedule offered to customers. The price schedule is Taylor-expanded to test the presence of quadratic pricing (Cawley and Philipson;1999);

$$P = C + \beta_1 Cov + \beta_2 Cov^2$$

P=unit price

Cov=Quantity of coverage

The constant term (C) is a fixed underwriting component and β_1 is the marginal price schedule that may depend on the size of the coverage. The theory of insurance under asymmetry information predicts that $\beta_2 > 0$. We test the presence of quadratic pricing for each homogeneous group of consumers. We did it by categorizing consumers group into each homogeneous risk; class of occupation and age for male insureds.

Class 1 occupation consists of those from administrative duties and those working indoor such as professionals, engineers (indoor only), announcer, manager, architect and draughtsman, clerk, teller, cashier, contractor (supervisory level only). And Class 2 occupation consists of artists, engineers (superintending and inspecting duties), supervisor, surveyor, baker, bartender, foreman, inspector etc. And those occupation which are hazardous e.g. car attendant, car washer, welder, bouncer, life guard, carpenter etc are included in the Class 3 occupation type. This classification of class of occupation enables insurer to impose different premium on policies consumers purchased. Therefore the premium per unit of coverage or unit price charged for each class of occupation is same. As the result, we may test the presence of non-linearity in prices for individual policy from the same class of risk level.

We test the quadratic pricing using data directly from insurance company. Since Health and Surgical Insurance is governed by authority in terms of premium charged, benefits offered (riders attached to the policy), marketing efforts etc, the sample data tested may well represent the industry as a whole. There are 168 policies tested for male category and 158 for female category for the year October 2003. It contains a limited set of demographic characteristics of the buyers, as well as features of policy including coverage size, and premium. The policies tested have common features and riders, it is to avoid incompatibility of policies due to different riders and benefits. (The sample policies are exhibited in the Appendix A).

We then tested the presence of non-linearity in prices using OLS regression on the model. Several methods are employed to test the quadratic pricing (log, quadratic, and linear regression) are used and we compare them using R^2 and AIC and SIC to determine the pattern of the plot to analyze the superiority of each regression for each class of occupation. The result of each statistical method is shown in the Appendix C.

While testing the non-linearity of prices for class of occupation, we also need to consider the income effect. Highly skilled individuals may earn more than the average workers from the same class of occupation type. This group of people may purchase higher quantity of coverage than usual consumers. Thus to simply assume higher than usual purchase must be high risk individuals may be incorrect, as these group of people may consist of directors, professionals, specially skilled engineers etc. This problem can be easily solved through assumption of competitive insurance market. In which consumers are maximizing his utility level; thus highly paid purchasers may need to buy larger than usual policies because of larger expenditures or responsibilities, higher probability of

becoming a target of kidnapping, and higher compensation to a company if he met an accident. This explains that there will be no income effect, which may distort our result in the analysis of quadratic pricing.

4.3 Logit Model For Covariance Between Quantity and Risk

We also examined the relationship between quantity and risk or relationship between risk and likelihood of holding larger coverage using logit regression model (Cawley and Philipson;1999);

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1(maritalstatus) + \beta_2(class2) + \beta_3(class3) + \beta_4(d1) + \beta_5(d2)$$

where d1 and d2 are age categories at 41-50 and 51-65 respectively. The dependent variable (logit value) takes the value zero if the sum insured is between RM20,000.00 to RM145,000.00, and one if the quantity of coverage is above RM145,000.00. Both class 1 occupation and age category 18-40 are bases. The logit value obtained is then antilogged and p is probability. The purpose is to analyze whether insured with higher risk e.g. married, in class 3 occupation would purchase larger insurance coverage.

The inclusion of individual's marital status is consistent with Lewis's (1989) findings in examination on demand for life insurance. The key determinant is the effect of breadwinner's decease on the consumption stream of his offspring, and other household's financial status. Thus the demand for insurance is larger for married individuals as their perceived risk is higher; this follows from the observation done by Lewis that the purchase of insurance represents transaction made on behalf of his household members. The marital status will take the value of one if the insured is married and zero if otherwise in the logit

model. There are 168 observations with common features of insurance benefits. The result is shown in Appendix.

The employment of these variables mainly is because they are observable. Consumers cannot cheat the insurance company regarding marital status, occupation type in the proposal. As if otherwise, the company is not liable for any loss incurred in the future. Therefore it renders the variables to be utmost important to evaluate the risk type of the consumers, and decide whether to offer the contract to them. Other variables, which are not directly observable may not be used for evaluation; e.g. participation in illegal racing, number of sticks of cigarettes smoked per day, may not be revealed by consumers at the point of purchase.

We will next examine the quadratic pricing for female category. The reason to separate male and female category is mainly due to different benefits of the policy purchased, different method for risk classification, and therefore the unit price for both sex category also varies. For example, maternity benefit is included in the female Health and Surgical insurance but not in male policy.

The classification into different age category for analysis is because categorization based of class of occupation is impossible for female insureds. The customers of this type mainly consist of workers in class 1 and 2 occupation type. Many of them also do not work or are housewives. Furthermore the nature of the jobs taken always render incompatible risk type between different class of occupation. (The type of policies offered for female category is shown in Appendix).

4.5 Conclusion

We analyze the presence of asymmetry information in Malaysia Insurance market by testing the pricing mechanism practiced by the insurers. Companies will break even when there is quadratic pricing for policies offered, it is to overcome the problems of informational disadvantage. Therefore the presence of the pricing strategy reveals that high risk individuals are assumed to be high purchasers and as the result they are charged at higher price.